

**Interreg
Danube Region**



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PilotInnCities

Annex no. 3

Germany

National quadruple-helix analysis

Responsible project partners:

ZDE ZENTRUM
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ENTWICKLUNG

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Introduction: initial situation

- Heterogeneous smart city landscape
- 73 model projects are actively implementing smart city applications in Germany, financed by model projects funded by the federal government
- Implementation priorities for Smart City topics are spatial effectiveness and open source development (in accordance with the Leipzig Charter)
- In Germany, work is being carried out on 6 core topics

In Germany, work is being carried out on 6 core topics German cities and also the German State are not among the smart city forerunners in Europe. One of the reasons for German cities to fall behind European counterparts, is the fact that the country is still deeply entrenched in the process of defining its strategy and objectives for a smart city development. These discussions are deeply embedded within a broader conversation on how to shape the digital transformation of German society, taking into account opportunities and risks associated with data collection, sustainability goals, and citizen participation.

The smart city landscape in Germany is therefore very heterogeneous and has been shaped to a large extent by the funding programmes to date. In particular, the 73 Smart Cities model projects of the Federal Ministry of Housing, Urban Development and Building set the direction due to their lighthouse function and the large financial volume of the programme. In addition to these model projects, there are a large number of different funding programmes that influence development in different ways. These include the following: The smart rural regions, the federal government's climate initiative, the mFund, centre funding for "Zukunftsfähige Innenstädte und Zentren" (ZIZ) and various state subsidies.

Germany's federal structure poses multiple challenges when it comes to coordinating stakeholders at the various levels. This has already led to conflicts of interest between the federal government and the federal states as well as between the pilot projects and the respective state when the federal funding was rolled out. These frictional losses meant that the projects were unable to realise their full potential. The approach of direct federal funding for local authorities led to misunderstandings in some places, as there was no coordination of the individual projects with the intermediate state level. As a result, the federal states were exposed to the risk that their sovereign and strategic objectives would not be sufficiently taken into account by the municipalities within the framework of the smart city projects. This hindered the widespread transfer of the results from the pilot projects.

Essentially, smart city development in Germany is trying to move strongly in the direction of spatial effectiveness and open source development, which is a result of the proximity to the Federal Ministry of Building and the Leipzig Charter. This is because spatial effectiveness, which is emphasised in the Leipzig Charter, is crucial for integrated urban development. This charter aims to strengthen disadvantaged urban districts and emphasise their functions in the overall urban context. Through spatially effective planning, cities can use their resources

efficiently and improve the quality of life in all neighbourhoods. The focus is also on sustainability and the common good, as this is also supported by the federal government's Smart City Charter. Spatially effective strategies help to shape digitalisation in a way that meets economic, social and environmental needs.

In Germany, there is generally a wide range of funding available, but the resulting projects differ significantly in terms of their themes. The decisive boost in smart city development in Germany was triggered on the one hand by the coronavirus pandemic and on the other by the aforementioned model municipality funding programme. Germany has recently been hit by a large number of different natural disasters, meaning that the area of climate impact adaptation is also gaining momentum in public discourse and project work.

In recent years, German cities have been very busy launching smart city strategies and initial implementation projects, but have realised that there is a lack of staff and knowledge. The smart city strategies have also made it clear that many of the necessary employees and job descriptions do not exist in administrations. This includes, for example, data analysts, programmers, and network and IoT experts. There is also a lack of a developer scene for open source software, which makes the implementation of the 'public money, public code' principle more difficult and also slows down implementation.

Realisation is also made more difficult by the parallel implementation of the Online Access Act, which ties up a lot of staff in municipal institutions and leaves little room for further smart city projects.

This has greatly slowed down the realisation of projects. The scene is characterised by its stakeholder landscape, which is made up of ministries, universities and organised solution providers with an official mandate, as well as independent players. We present this structure separately under the ecosystem or stakeholder map.

Although the existing projects are increasingly affecting rural areas, they are still strongly focussed on metropolitan regions, at least in terms of solutions. During the strategy phase of the 'Smart Cities Made in Germany' model programme, it quickly became clear that the requirements for smart city and smart region projects differ drastically between urban and rural areas. The experience of the first phase of the Smart Cities model municipalities revealed the need for a 'Smart Cities and Regions' step-by-step plan that structures the next action steps for all stakeholders involved. Such a step-by-step plan has been available since June 2024 and is now being gradually implemented. This step-by-step plan will be discussed in more detail elsewhere with reference to the stakeholder landscape.

Another major obstacle to the consistent implementation of smart city projects in Germany is the lack of realisation of the benefits in many places among the designated implementers, i.e. the local authorities and in some cases also the heads of administration. This is due to a lack of digital expertise and a lack of understanding of data management. As a result, implementation is hampered, as this does not motivate the population to participate and the

'spark' is not ignited. The major topic of 'data governance' and its importance for the future of public administrations is not yet sufficiently anchored in the reality of public administration. However, a trend reversal can be recognised recently, as on the one hand a generational change is taking place and on the other hand the legal framework is slowly changing, not least due to increasing pressure from the population, e.g. in social and sustainability-related issues. All in all, it can therefore be said that the foundations for the successful sustainable and digital transformation of cities and regions in Germany are in place. There is a need for action with regard to the question of how projects can be implemented quickly and effectively within the federal system in view of the complex situation described above. However, no smart city project can compensate for the inadequate digital infrastructure in Germany. Germany is one of Europe's laggards when it comes to fibre optic expansion, and there is also no nationwide IoT infrastructure. On the positive side, it should be noted that the smart city model projects have led to a rethink among many people in this respect and a trend reversal can be expected here, as the need for high-performance basic infrastructure has been revealed. Given the large number of current challenges at municipal level, the question of prioritisation is imperative. Network expansion has to compete with many other issues, such as the creation of living space. Current priorities in the implementation of the smart city and smart region strategies that have been developed are:

1. **Optimisation of mobility:** The development of intelligent transport systems that optimise local public transport and make private transport more efficient is a key issue. This also includes e-mobility and car-sharing models.
2. **Data-based energy efficiency:** Many cities are focussing on sustainable energy concepts, such as the use of renewable energies and improving the energy efficiency of buildings, and want to make these controllable and digitally recordable via IoT applications.
3. **Development and implementation of a convergent digital (data) infrastructure:** The expansion of broadband, mobile communications and IoT sensor networks and the creation of a digital (data) infrastructure are crucial to enabling the networking of devices and systems.
4. **Citizen participation and closing the digital literacy gap in Germany:** The involvement of citizens in decision-making processes and the use of digital platforms for communication and co-design of urban development projects are also important aspects. Even more important is the development of knowledge about digital competences in the administration and thus the empowerment of the administration in dealing with Smart City applications and thus the reduction of fears.
5. **Security and data protection:** The implementation of security concepts and the protection of personal data are key issues that must be taken into account when developing smart city solutions.
6. **Development of climate data and climate impact adaptation:** Due to the current extreme weather events, climate applications, data and climate data analysis play a

fundamental role in all smart city strategies in Germany, and the topic is gaining momentum due to disasters.

To summarise, it can be said that the German urban and rural district ecosystems, supported by funding from the federal and state governments, has set out to address the topic of smart cities and smart regions. However, this is happening more slowly than in other EU countries. Parallel to the Smart City efforts, the digitalisation of the administration is also running through the Online Access Act, which in turn ties up resources in administrations and thus slows down both processes. Added to this are the different budgetary situations of the municipalities and the lack of specialised personnel (experts) in Germany. However, the chosen funding path remains exciting and it remains to be seen how the cooperation between the municipalities and other project partners will result in viable solutions and whether the administrative world will manage to see open source developments as 'enablers of innovation' and utilise the development opportunities for digital services of general interest. If this succeeds with the new phased plan (June 2024) and the marketplace for local authorities, there is a chance that a dedicated 'smart ecosystem' will develop in Germany that can play an active role in the European urban and regional system. In this respect, it is exciting to see how smart city projects can be piloted quickly so that users such as citizens or companies in particular quickly recognise the added value. The results of the survey clearly show that the stakeholders are at different stages in this respect and that knowledge and experience still diverge.

PART 1: survey results

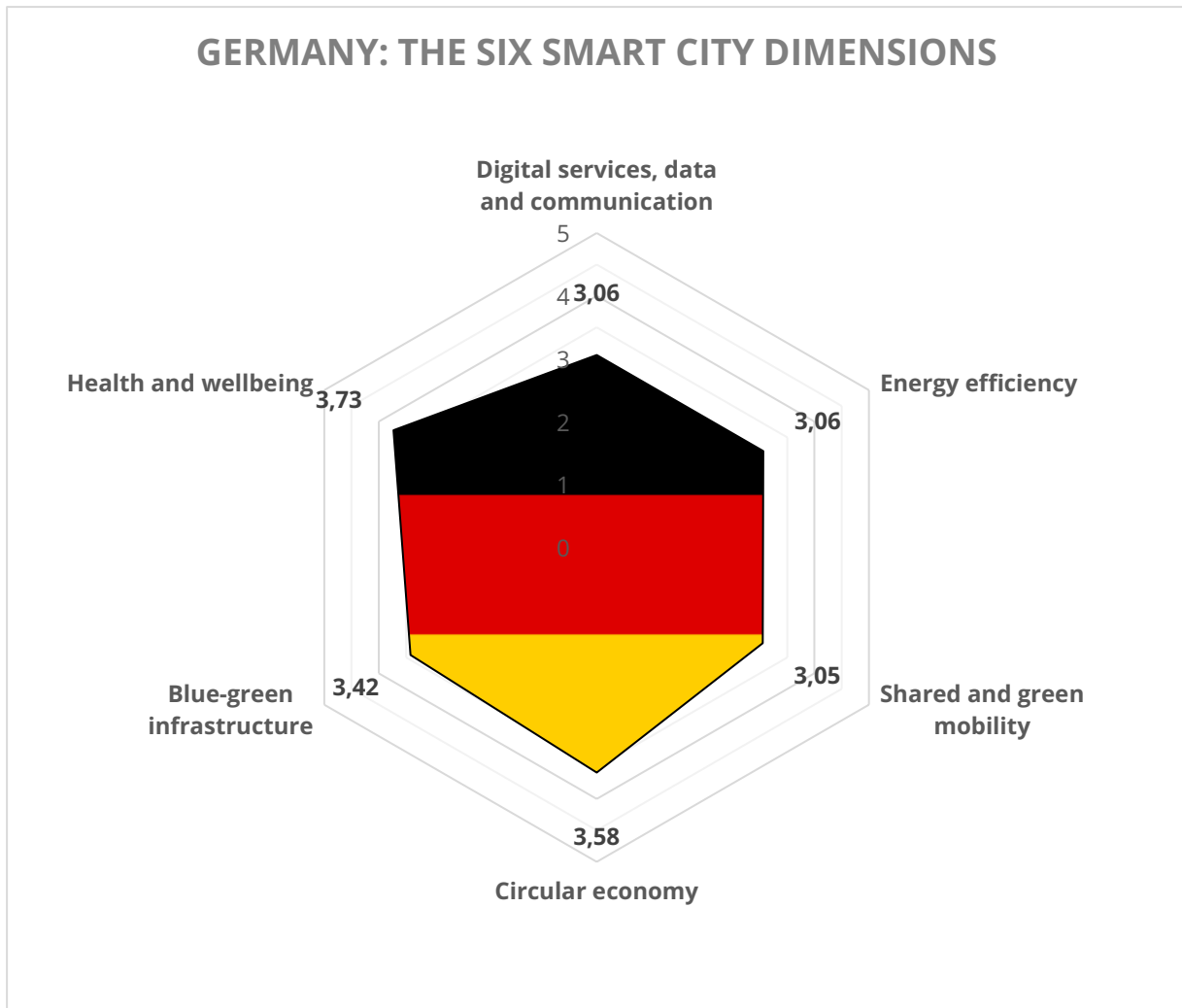


Figure 1: Radar chart showing the benchmark of six Smart City dimensions in Germany

The results of Germany's smart-city-benchmarking displayed in *Figure 1* are the combination of the 3 different benchmarkings done. Namely: our own PilotInnCities survey results, the Bitkom Smart City Index (Benchmarking the 80 biggest cities in Germany) and the [German Digital Decade Evaluation](#) (Benchmarking the Digital Infrastructure State in Germany). All KPIs from the latter 2 benchmarkings have been appropriately converted to the PilotInnCities dimensions and all scores have been averaged out by the end, resulting the final scores visible in the graph.

The PilotInnCities Survey responses were received from 25 cities throughout Germany. These included both large and small municipalities. A certain cross-sectional character of the smart city scene described above can therefore be assumed. Eventhough the low response rate does

not guarantee representativeness, the results have been justifiably in line with those of bigger surveys like the Bitkom Smart City Index and others since our survey focused more on the perception of the respondent to some aspects as opposed to rating the existing infrastructure as done by the other two benchmarkings. All around, our survey scores have been just behind the literature scores, but this is noticeable the most for: - **“Digital services, data and communication”**; scored **2.37** out of 5 through our survey but the literature evaluation was at **~3.4**. - **“Health and Wellbeing”**; scored at 3 but the literature evaluation was at **~4.1**. - **“Energy Efficiency”** & **“Shared & green mobility”**; both scored **2.8**, just shy of the literature evaluation at **3,3** points.

One fundamental finding is that a small number of leading cities are rated as very good in terms of their digital services and smart city applications and are addressing these issues proactively. This is followed by a broad midfield of active municipalities that have recognised the topic for themselves but are still a long way from consistent implementation. Another significant proportion of cities ranked unsatisfactorily in the assessment of their digital offerings.

Based on the initial situation described above, there is a risk of a split between digitally savvy ‘frontrunners’ and digitally lagging locations. The latter already have noticeable disadvantages in terms of location development (influx of skilled labour, departure of companies, departure of younger administrative staff, efficiency deficit, failure to meet binding legal requirements, cost increases, etc.) and this trend will intensify in the coming years if no countermeasures are taken as quickly as possible. If there is a lack of engagement with digital topics of the future, the impact on locations goes beyond the direct mechanisms of action: in many places, a ‘brain drain’, i.e. the exodus of qualified young top performers, is noticeable for the economy and society. This potentially creates a downward spiral, as the location also becomes unattractive for business relocations and developments. Locations that recognise this significance, draw the right conclusions and implement the necessary measures will prosper in the competition between locations. This is shown by various European examples such as Stockholm, Helsinki and Tallinn. Digital location advantages can also be utilised in rural areas if the necessary infrastructure and services are created. For knowledge-intensive professions in particular, rural areas offer real alternatives to urban centres, provided that fast internet, mobility and local amenities are guaranteed.

On a positive note, the majority of the municipalities, districts and holdings surveyed recognise the importance of smart cities and digitalisation. Naturally, however, this finding does not allow any conclusions to be drawn about society as a whole, as the survey participants can be expected to have a positive basic attitude towards the topic.

The results of the survey on the availability of digital services in local authorities clearly show the current state of change and transition in Germany. In many places, problems have been recognised and measures introduced, but the results of these efforts are not yet reliably available across the board. This interpretation is also significant when it comes to the user-

friendliness of existing services. 92 per cent of respondents see a clear need to catch up in terms of communication channels between local authorities and citizens, which are often perceived as outdated.

The same distribution of a broad midfield with small proportions of leaders and laggards was found for perceived energy costs and the modernity of energy networks.

The existing mobility services are rated significantly negatively: 44 per cent of respondents describe the public transport services in their region as 'poor'. 60 per cent state that they are inflexible in their choice of mobility solutions due to the services on offer. This is in line with larger surveys in Germany and represents a challenge with regard to the climate goals of the transport transition.

In the area of recycling management, 56 per cent of participants gave the existing recycling systems good marks. Only eight per cent felt that the offerings were inadequate. In contrast, further concepts for the local circular economy are rated more evenly in terms of their awareness and usability. 24 per cent currently see a poor offer here, 36 per cent a good one. The urgency of measures seems to be less pronounced here than in other fields of action, at least according to the survey results. The water infrastructure is rated well by the majority.

One striking result is that 40 per cent of respondents rated the consideration of aspects of urban planning that are highly relevant to climate impact, such as urban greenery, water in the city or the identification and combating of heat islands in general, as insufficient and 40 per cent as sufficient.

In the area of health, almost half of those surveyed gave the digital availability of health services a poor rating. The quality of urban living spaces in terms of air and water quality as well as light pollution is rated as very balanced on average on the spectrum from 'good' to 'poor'.

When asked about the biggest obstacles to implementing innovative solutions, most respondents cited 'bureaucracy', 'slow internet', 'lack of budget', 'excessive regulations' and 'high costs'. Digital innovation in the area of citizen services, data-based administration and digital communication is seen as the greatest lever, followed by energy efficiency and mobility issues.

Figure 2 highlights the very strong dissatisfaction with the in-use communication tools from the municipalities and regional authorities with a score of 1.48., although the digital systems and services deployed are rated neutrally on user friendliness with a score of about 3. Across the different dimensions, the majority score just shy of 3, the neutral point, except for Q8 regarding satisfaction with the recycling systems and Q10 regarding the water infrastructure, the scores are respectively 3.6 and 3.68. This highlights what could be considered as relative strengths within the German ecosystem.

GERMANY: BENCHMARKING QUESTIONS

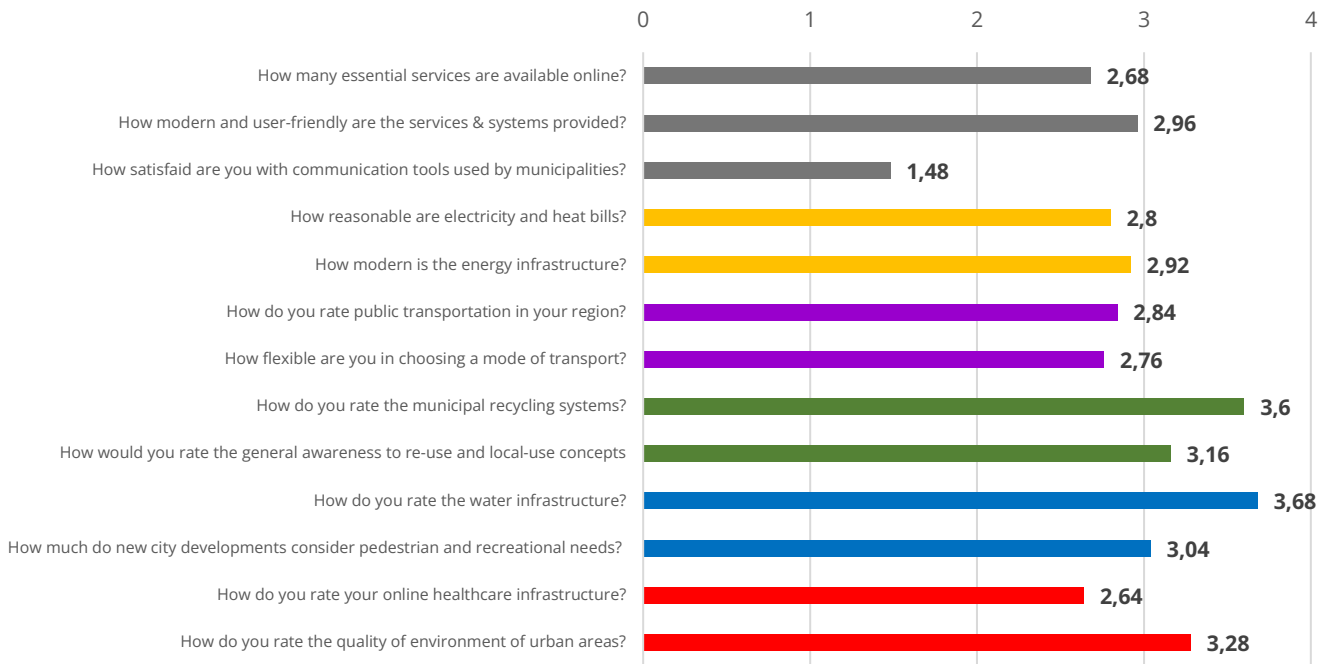


Figure 2: Overview of the survey questions and their related respective scores. The ranking was done on a 1 to 5 scale; 1 reflecting the least amount of satisfaction and 5 reflecting the most.

GERMANY: PRIORITIES FOR SMART TRANSFORMATION

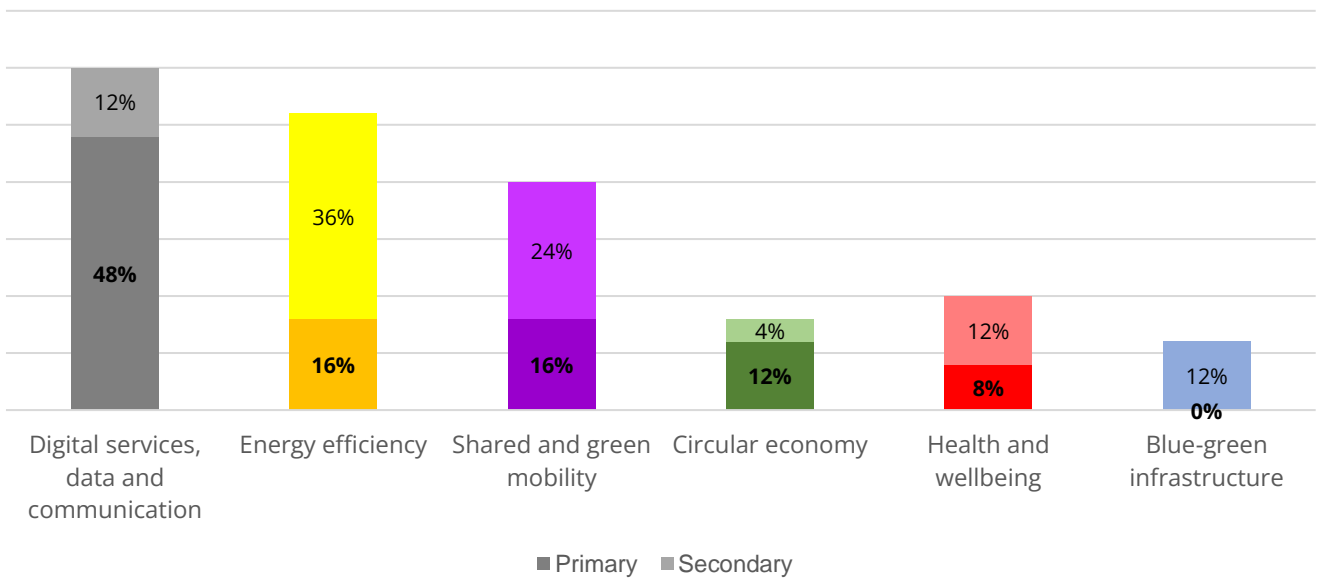


Figure 3: Dimensions ranked from most to least in-need of smart transformation following the respondents' survey response.

PART 2: ecosystem mapping

The “stakeholder map” of the German smart city landscape can be created or conceptualised on two levels: the meta level and the micro level. The meta level describes the ‘stakeholder landscape’ on the basis of the funding programme, specifically from the perspective of the funding provider as a top-down process. The evaluating body already has its own current stakeholder map developed as part of the federal funding programme. This has been incorporated into the present analysis and has been linked on the basis of the analysed intersections. This stakeholder map is shown in *Figure 1 – Stakeholder map Germany: From the perspective of the evaluating body for “Smart Cities Made in Germany”*. The illustration is based on the evaluation of four years of federal funding for Smart Cities Made in Germany.

The micro level looks at the path taken by the local authorities, i.e. the local implementers. The driving players in Germany are largely characterised by public authorities such as cities and districts. Digital agencies and municipal utilities as well as private players (companies) are only marginally involved in the implementation as public sector participants. What is new is the realisation that the stakeholder structures have evolved as one of the first results of the federal funding through the smart city strategy developments and that some new structures are now forming in the model municipalities. Some of these are emerging as new municipal holdings, for example as “digital agencies”, as independent municipal or regional companies or docked onto municipal utilities. Here, too, an organisational change is taking place in the administrations, which is expressed in new professions such as smart city manager, data broker and data analyst. These are inherently necessary, but the corresponding training programmes are not yet sufficiently anchored in the administrative universities. The expertise currently available in these professions is therefore based on knowledge transferred from other sectors, adapted experience and specialist knowledge acquired, for example, as part of further training.

Both levels of the stakeholder analysis differ in terms of how they are perceived by the actors involved. For example, although the funding providers play an initialising role in the implementation process, they become less important during implementation on the ground because they tend to slow down implementation due to a high level of regulation. Intermediary institutions that take on the evaluation of the funding on behalf of the funding provider also create new bureaucratic obstacles and theoretical, non-practical processes, thus presenting local authorities with major challenges in addition to the content-related issues. In many cases, a problem then has to be solved individually at state level over a long period of time.

As a result, the development of smart city structures and the stakeholder landscape is slowed down by the multi-layered nature of the funding. At the micro level in particular, it is noticeable that there is uncertainty about funding because there is a very wide choice in this respect. This also distinguishes Germany from other countries in the EU. Cities can choose from state,

federal and EU funding. However, the latter are becoming less and less popular with cities because they often do not have the professions to actively manage EU funding. In most cases, this expertise can only be found in municipalities with a population of around 100,000 or more. This makes it difficult for cities to access funding and European networks. However, this is also due to language barriers, as foreign language skills in administrations are comparatively weak.

Based on the analysis carried out and the insights gained for the German tandem partners, it should be noted that, due to its own federal structure, Germany has initiated a top-down process for the smart city and smart region movement at the meta level, which was the right approach at the beginning of the pilot projects in order to set the necessary development in motion. What is striking about this approach is that smart city development is only taking place slowly. However, the top-down model also takes into account the bottom-up approach because, for example, citizen participation in the municipalities was to be integrated as an important element of the strategy or as a requirement.

The entire national level is therefore included at the meta level. This observation is also in line with the presentation from the new Smart City step-by-step plan (June 2024) and the results of the current survey. As described in the initial situation, smart city and smart region development is still heavily dependent on funding. It can therefore be stated that smart city development in Germany is strongly characterised by top-down development at the meta level, but that the federal structures are not properly taken into account at the federal level. This creates tensions and, in some cases, unintentional duplicate structures such as marketplaces, similar funding pools and different objectives. It is also problematic that all approaches promote the 'bottom-up approach' and that citizen participation in particular is repeatedly called upon here. This hinders implementation. The development of a smart city or smart region ecosystem in Germany is also hampered by an overly complicated and rigid public procurement system, which tends to inhibit new agile approaches. In addition, the complex award procedures mean that consortia have to be formed where only companies with detailed references and many years of project experience can be awarded a contract. This often discourages young companies and start-ups from taking part in smart city projects and further slows down development. As a result, the market remains closed and tends to be distributed among larger and established market players.

The main players in smart city applications, strategies etc. are usually to be found at federal ministry level and initiate the municipal implementation projects from this level.

Particularly worthy of mention are:

Federal Ministry of Housing, Urban Development and Building (Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen, BMWSB)

Smart Cities pilot projects: This ministry plays a key role in funding pilot projects that test innovative approaches to integrated urban development. A total of 73 projects were supported with around 820 million euros to drive forward the digital transformation in cities and regions.

Federal Ministry of the Interior and for Home Affairs (Bundesministerium des Innern und für Heimat, BMI)

Coordination and transfer centre: The BMI is also active in supporting smart city initiatives by promoting the transfer of knowledge between the funded projects and other municipalities. It plays a key role in the implementation of the Smart City Charter and the national dialogue platform.

Federal Ministry for Economic Affairs and Climate Protection (Bundesministerium für Wirtschaft und Klimaschutz, BMWK)

Financial support: This ministry provides funding to promote digitalisation and sustainable development in cities. It supports projects that integrate both digital solutions and climate-friendly technologies.

In addition, there are various funding programmes supported by these ministries, such as the National Climate Initiative (NKI) and "KommKlimaFÖR", which are specifically aimed at the needs of municipal utilities and municipal companies. These programmes offer financial support for projects that introduce innovative technologies and contribute to the reduction of greenhouse gas emissions.

Most of the dimensions of the Quadruple Helix are covered by the inclusion of scientific monitoring and the condition of citizen participation in the funded projects. Nevertheless, a top-down approach is more recognisable in Germany in terms of process.

The map shows the repartition of Stakeholders in Germany on two levels, the meta level -federal- and the micro level is represented only for the state of Bavaria. The actors on the federal level are interconnected through multiple large initiatives and mapping more than one at once would make the graph incoherent, especially since the consortia greatly overlap. On that basis, we opted to map the most recent initiative; **the phased plan Smart Cities and Regions** which builds off of previous finished federal projects and envisions the grounding of "the Competence Center for Smart Cities and Regions" by 2025. The competence center is an objective of the BMWK's phased plan, which is in the planning stage and has already been formulated. At the time of the survey, it was not yet clear to what extent the center was being implemented and its strategic placement within the state-specific ecosystems and existing actors (Digital hubs, State Agencies and Ministries etc..) remains to a large part under-defined.

However, the stakeholder map makes it clear that the federal smart city/smart region process requires a more centralized coordination body that pools resources and provides orientation and an overview for the Federal states, districts and municipality level. If this development does not come about due to the current political changes, the process is in danger of failing at the meta level. It is also striking that the micro and meta levels are not directly connected because the state ecosystems are not sufficiently linked to the federal funding landscape. These interfaces should be more strongly emphasized.

The presentation of the stakeholder map in Germany also still lacks the views of the corporate landscape, which is hardly considered as an actor in the lists of the afro-mentioned phased plan. Rather, the market is divided between companies that are closely linked to the funding organisations. The corporate players should be more closely involved in the considerations of the future marketplace and the competence center. This will create the opportunity to sustainably shape and continue the good path taken by the “Smart Cities Made in Germany” funding programme and to develop an active smart city ecosystem.

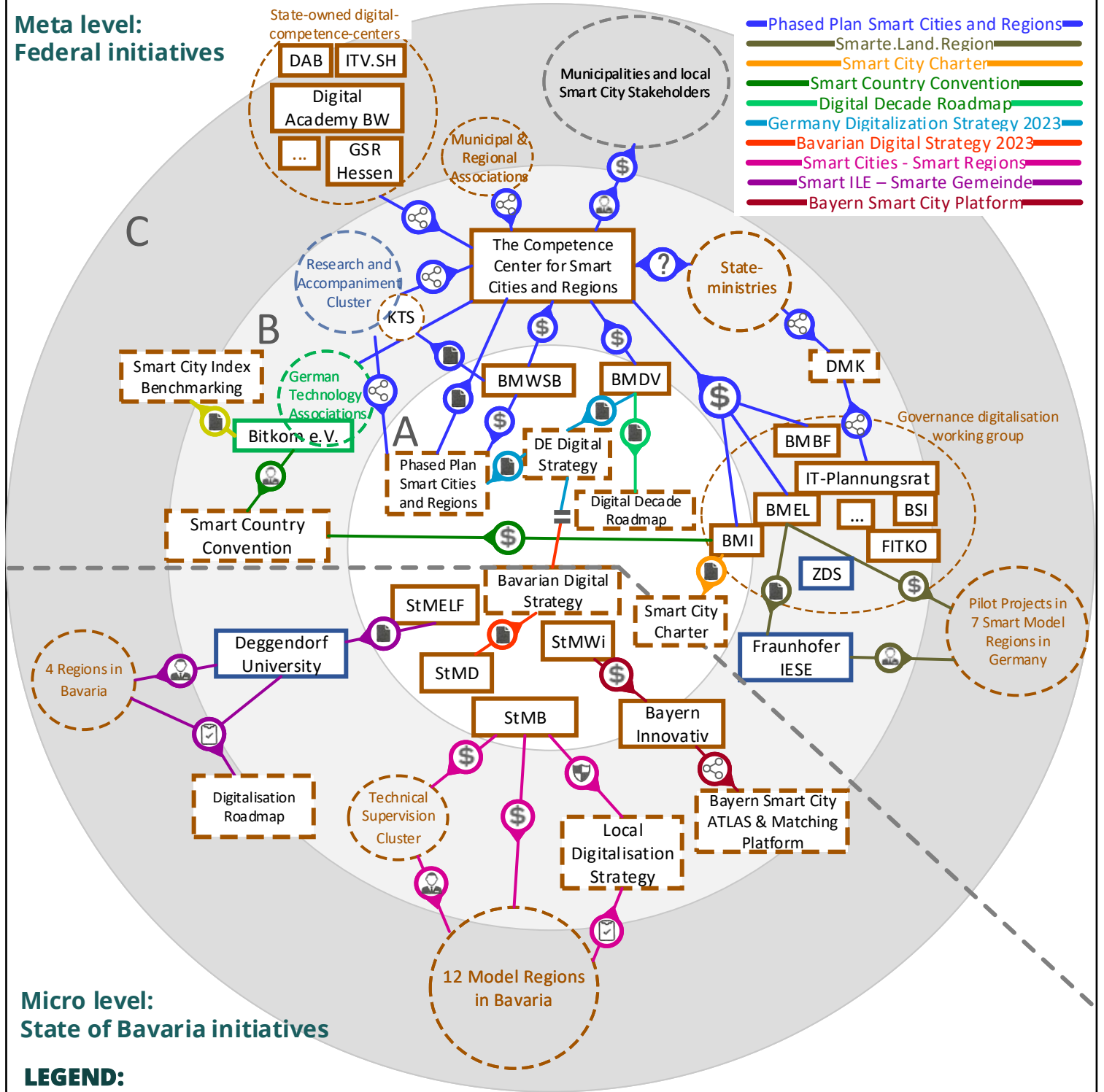
The previously mentioned disconnect between the federal level and the individual state levels is also evident in this representation. In the case of Bavaria, various stakeholders and initiatives are already underway, and multiple strategies and roadmaps are being developed. However, there is no clear alignment with the federal strategies. While the Competence Center aims to address this gap, it remains unresolved for the time being.

The smart city stakeholder ecosystem in Germany is very rich and mapping all initiatives will not be very challenging if not impossible. Therefore, the mapping presented does not make a claim for comprehensiveness. It certainly falls short in detail compared to redaction but the graphical simplification serves to highlight an underlining trend within the Smart-City ecosystems in Germany. For example:

- The competence center for smart cities has not yet been inaugurated and it is unclear if the recent changes in the government will facilitate or challenge its creation. It has been nonetheless mapped because it brings together a significant number of actors that have been axial to other federal SC initiatives. These actors are listed in the “Phased Plan Smart Cities and Regions” in more detail.
- The Deggendorf University's Smart City action –although impactful within the region– dwarfs in comparison to how other –bigger– universities are engaged (most notably Technical University München). The choice of visualizing it over bigger actors aims to show a peculiarity in the German (or at least Bavarian) ecosystem: even relatively small universities are facilitating local SC actions.

Germany Smart City Ecosystem Map:

Meta level: Federal initiatives



Micro level: State of Bavaria initiatives

LEGEND:

| | |
|--|---|
| DAB: Digital Agency Brandenburg | BMBF: Federal Ministry of Education and Research |
| Digital Academy BW: Digital Academy Baden-Württemberg | BMI: Federal Ministry of the Interior and Community |
| DMK: Digital Ministry Conference | BMWSB: Federal Ministry for Housing, Urban Development, and Building |
| FITKO: Competence Center for IT and Digitalization | BMDV: Federal Ministry for Digital and Transport |
| Fraunhofer IESE: Fraunhofer Institute for Experimental Software Engineering | Bitkom: Federal Association for Information Technology, Telecommunications, and New Media in Germany |
| GSR Hessen: Office for Smart Region Hessen | StMB: Bavarian State Ministry for Housing, Construction and Transport |
| IT-Planungsrat: IT Planning Council | StMELF: The Bavarian State Ministry for Food, Agriculture, Forestry, and Tourism |
| ITV.SH: IT Network Schleswig-Holstein | StMD: Bavarian Ministry of Digital Affairs |
| KTS: Coordination and Transfer Office for Model Projects in Smart Cities | StMWi: Bavarian Ministry of Economic Affairs, Regional Development, and Energy |
| BMEL: Federal Ministry of Food and Agriculture | ZDS: Research Institution for Digital Sovereignty |

PART 3: SWOT analysis

STRENGTHS

- **Proactive academia and industry in the field of Smart Cities (academia & industry)**

Germany does have ample expertise within its borders not only for the implementation of smart city solutions but also for the further development of the state of the art. Universities continually are researching new innovative concepts and the vast majority do provide startup incubators within their premises for students. Public and private research centers alike, most significantly the Fraunhofer institutes, are continually studying new urban development concepts. On the other hand, the local market for smart city solutions is well-supported by a wide range of German technology providers and expertise.

- **High level of awareness and engagement (civil society)**

It is safe to say that actors within civil society as well as private persons in Germany are by-and-large empowered enough to engage in meaningful ways with the local authorities. The civil society in Germany has been on many occasions and is still a motor for change and it could, if correctly addressed, be a powerful catalyst for Smart City changes.

- **Nation-wide coordinated initiation (government)**

The development of the “Smart City Charter” as a guideline for German cities and the funding program “Smart Cities Made in Germany” were the first important steps towards advancing the concept of Smart City and Smart Region. The result of the last three years are the ambitious smart city strategies of the 73 funded locations and an ever-growing smart city scene propagated through these first light-house projects.

Overall, the ‘Smart Cities Made in Germany’ funding program shows that Germany is pursuing a systematic and comprehensive approach to the development of smart cities. The combination of financial support, strategic planning, knowledge transfer and international networking as requested in the regulations of the funding program positions Germany as an active player in global smart city development. The long-term orientation and the focus on the transferability of solutions indicate that Germany is aiming to develop sustainable and scalable smart city concepts that can also attract international attention.

- **Inclination for cooperation – digital awareness – open data and open source (government)**

Cooperation is not alien to cities and regions in Germany. We often find associations being inaugurated that bring together neighbouring regions and cities for a common – mostly development and resilience related – cause. On the other hand, municipalities are not digitally disengaged. Most already have in-house IT personnel, GIS data bases and other useful resources for smart city development. This is enhanced with the availability of a wide range of

open-data portals in each federal state. These three factors create a fertile environment conducive to successful smart city integration. Through the regulation of the federal funding programs, namely the principle called “public money, public code”, a developer scene for the public sector is slowly developing. This is a positive development and can become a strength for the public smart city/smart region market. However, the developer scene can only grow slowly, because there are no clear profession profiles yet for such developers in public administrations.

- **Independent and decentralized regional public utility providers (government & industry)**

Public utilities in Germany are mostly managed by local public companies. This is advantageous to initiators as it greatly simplifies the local stakeholder maps and project consortia. It also insures the availability of in-depth knowledge on the local infrastructure. Although this hinders wide-scale deployment of certain technologies, it is rather ideal for SMEs looking to get into small markets first.

WEAKNESSES

- **Strategies between the federal government, states, and municipalities are not interconnected and there is a lack of orientation on how to move from strategy to action (government)**

An omnipresent weakness of Smart City and Smart Region development compared to other EU countries is the lack of a harmonizing national strategy. This problem has been approached through official releases like: “the smart city charter”, “the Phased Plan for Smart Cities and Regions” and to a less-pertinent extent “the National Digital Decade Roadmap”, but still there is no binding strategy that sets Smart City actions on fast tracks. The key values from the biggest funding program so far, the “Smart Cities Made in Germany”, are unfortunately not nationwide in the implementation due to the lack of involvement of the federal states, so that each state currently has its own smart city/smart region policies and ecosystems. The complex and multi-layered funding landscape in Germany is a clear symptom to this problem. This hindered the capacity of some state-funded initiatives and programs from reaching their target groups. Also, for small municipalities, the federal multi-layer structure creates some difficulty in finding the right path of entry in certain situations, and this already is true on national level, without even mentioning the European Smart City level which only a few municipalities make use of in terms of cooperation and exchange. Language skills are also still a problem for administrations and hinder European networking. Additionally, the multitude of highly specialized tasks allocated to the municipal level collides with a general lack of specialized staff in small municipalities, creating an overwhelming situation. Thus, the federal system is certainly not the most efficient one with regard to overarching, interdisciplinary topics such as Smart Cities. As a result, the Smart City landscape in Germany is highly

fragmented and the approach to finance basically all projects via public funding from several levels (federal, regional, district) costs time in implementation. The administrative structures have failed to develop important digital skills and expertise in training and education, so there is a lack of specialists like smart city managers, data analysts and IoT specialists. These professions are only now slowly emerging thanks to the funding landscape. This weakens the implementation of smart city projects. Another weakness is that, driven by funding, Germany prefers to invent smart applications itself rather than use existing templates and adapt them to its own system. In terms of lighthouse character, Germany is losing speed as a result.

- **The average municipality is limited in size, resources, staffing and engagement (government)**

The average municipality size in Germany is about 7,500 inhabitants per municipality ([source](#)). That means, the average municipality in Germany presents too small a market for private technology providers. Furthermore, most municipalities of this size are limited in resources, making not only the uptake of smart city technology challenging but more so its upkeep, due to missing/insufficient competences. And to further compound the issue, Smart City technologies are often seen as a nice-to-have feature but nothing worth pursuing in the sense of a future-proof service of general interest.

- **Strict and overwhelming funding structures and regulations for municipalities (government)**

Municipalities are reliant on public funding for the implementation of projects. Each application requires extensive resources to be invested in the planning and the sponsoring-body is vigilant about the hallmarks of the projects to be selected. There is a plethora of structures and funding programs to support financially weak Municipalities, but the municipalities are very restricted in terms of how they could allocate the budget. On top of that, funding programs that are somehow related to Smart Cities are usually very specific and focussed on a singular aspect (for example EV-charging infrastructure, energy efficiency in residential buildings, GIS data acquisition). Since smart city concepts are overarching between different dimensions, the current system quickly overwhelms cities who are seeking to fund their digital transformation. This leaves municipalities tied up between trying to navigate the complex funding structures on state, national and EU levels and not finding an allocable budget towards local smart city endeavours.

- **Slow implementation capacity (government)**

Another weakness lies in the slow implementation speed of the Smart City projects by the regional administrative organizations. This is partly due to a lack of willingness to innovate, insufficient in-house digital and data competencies, inadequate networks and low knowledge & best-practice knowledge transfer. This attitude is further re-enforced by a rigid higher-up administrative structure that disfavours agility (Legal aspects, data protection laws, procurement procedures...).

OPPORTUNITIES

- **No standardized integration concept of Smart City solutions for municipalities and districts (industry)**

Since the task of developing custom digitalization roadmaps is, justifiably, proving challenging for municipalities and districts, there is a high need for the procedure to potentially be standardized and simplified by experts in the field. Potentially, the resulting product could be a step-by-step guide or pre-defined solution “packets” that ensures the comprehensiveness of the digital development. This is especially interesting for small municipalities with insufficient in-house capacities. By the open-source focus, there is the opportunity that sustainable smart city services are established in conjunction between industry players and public entities, thus creating a strong and active ecosystem in the middle of Europe. The open-source approach may be challenging in terms of implementation, but effectively prevents the risk of vendor-lock-in effects and inefficient software solutions. The early involvement of ecosystem members through federal funding enables the development of a smart city industry. The highly data-centred approach bears opportunities in terms of climate change related risk reduction, fostering further green industry development.

- **Predisposition towards lighthouse projects (industry)**

Acknowledging the lack of digitalization and the pressing need for it, Smart City initiatives in Germany, especially the ones initiated by federal ministries, often are deservedly underlined with a “lighthouse project” label. Lighthouse projects represent the willingness to change the status quo, and they serve as pillars to future developments and policy changes in the digital -and by extension Smart City- landscape. Staying informed about the newest initiatives, of which there are a few, represents an opportunity to all Smart-City stakeholders. The existing lighthouse projects have the potential to be connected and continued on European level to make maximum use of possible synergies. [Find a primary list here.](#)

- **Federal facilitation plans / the Competence Center for Smart Cities and Regions (government, civil society, academia & industry)**

Based on the lessons learned from the nation-wide program “Model Projects Smart Cities”, a new federal bureau named “**the Competence Center for Smart Cities and Regions**” is anticipated to be founded in 2025. It seeks to create a central hub for addressing strategies and solutions integration on federal, state, and municipal levels as well as promoting collaboration and resource sharing among various Smart City stakeholders. The center, through offices in each German state, aims to strengthen local ecosystems, enhance digital services, and ensure that municipalities can effectively implement modern technologies to improve public services. The use of existing European structures such as the European Digital Innovation Hubs in Germany could increase efficiency and ensure better coordination between smart city initiatives. [Read more...](#)

- **High self-awareness and ambitious goals (government)**

Although lacking behind in tangible strategic changes, Germany is well-aware of its baseline as best expressed in the opening line of The German Digital Strategy: “Germany needs a comprehensive digital transformation”. The Strategy lists and defines a set of comprehensive digital goals that engulf civil society, economy, research and governance. Since the exact implementation method is still -as far as this document is concerned- an open question, a lot of opportunities might arise which stakeholders will need to stay up to date about.

THREATS

- **Reluctance to spearhead (government)**

As Europe’s industrial motor and one of the strongest economies in the world, Germany’s presence has been -at best- reserved when it comes to status-quo-defining transnational initiatives in the Digital Transformation & Smart-City fields. Be it EU funding for sustainability and energy efficiency like ELENA (ELENA Projects in Europe), EU-wide Benchmarking System for Smart-Cities like LORDIMAS, the inauguration of a European Digital Infrastructure Consortium for Digital Twins (LDT citiVERSE EDIC) or innovative Smart-city piloting projects like Community. The German Smart-City ecosystem is not benefitting from these valuable initiatives as much as it could, and in the long run, this could only lead to widening the gap between the Smart-City state of the art and the German experience.

- **Digital literacy gap (civil society, government, industry & academia)**

Digital literacy proves to be relatively low in many German organizations as well as in certain areas of civil society. This hampers quick implementation of “digital first” solutions and, thus, smart city initiatives. Given the generational component of this issue, it becomes clear that it is a multi-layered challenge involving both public and private sectors. Also, this highlights structural deficiencies in the German educational system. Academia like a spearhead in this area, engaging in many highly innovative projects, but through lacking linkages between academia and industries as well as government organizations, these novel approaches often remain theoretical and lack practical implementation.

- **Lagging back internationally as a result of home-made internal complexity (government)**

German municipalities and districts, in many cases, are overwhelmed by the structural complexity of German funding and organization within the federal system. As a result, they do not have sufficient capacity to participate in European and further international initiatives. Therefore, the German ecosystem lags behind in certain regards because of the lacking international perspectives.

Conclusion

The German approach to Smart City development is characterized by caution, vigilance, and a slower pace. The risk is that this approach may fall behind the rapid pace of technological advancements in the private sector and in other European countries and cities that are quickly gaining experience from trial projects of smart city applications. However, this approach has the potential to result in a well-grounded, inclusive understanding of what smart cities should deliver to citizens and how they can be optimized to promote welfare-oriented development. If successful, it could serve as a model for how to balance citizens' and other stakeholders' interests and concerns while promoting smart and sustainable cities.